63-1-4

REPORT NO. FGT-2228
DATE: 30 October 1962

HYDRAULIC SYSTEM - ORONITE 8515 PRESERVATIVE FLUID - EVALUATION OF

Published and Distributed Under
Contract No. AF33(657)-7248

GENERAL DYNAMICS | FORT WORTH

C O N V A I R
A DIVISION OF GENERAL DYNAMICS CORPORATION
(FORT WORTH)

Department 6
FWP 1999-9-54

TEST F-7164
MODEL B-58

REPORT FGT-2228
DATE 7 April 1959

TITLE

HYDRAULIC SYSTEM - ORONITE 8515 PRESERVATIVE FLUID - EVALUATION OF

SUBMITTED UNDER

Contract AF-33(600)36200

The tests described in this report were conducted between 27 January 1958 and 1 November 1958.

PREPARED BY: R. H. McDaniel
R. H. McDaniel

GROUP: CHEMISTRY SECTION ENGINEERING TEST LAB.

REFERENCE: See Page 8

CHECKED BY: Paul N. Stoffel

APPROVED BY: P. S. Klevem

NO. OF PAGES 13

NO. OF DIAGRAMS 4

REVISIONS

NO.	DATE	BY	CHANGE	PAGES AFFECTED

HYDRAULIC SYSTEM - ORONITE 8515 PRESERVATIVE FLUIDS - EVALUATION OF

PURPOSE:

At the time this test was initiated a variety of fluids were being employed as preservative oils in component parts of the B-58 hydraulic system. All of these oils, because of their incompatibility with the synthetic base fluid used in the "Hustler's" hydraulic system, must be flushed from the parts before they are installed on the airplane. The present hydraulic fluid does not offer a high enough level of corrosion protection to warrant its usage as a preservative fluid. Therefore, a special preservative fluid which will protect the hydraulic units of the B-58 during shipment and/or storage and which is compatible with the hydraulic fluid now in use would be most desirable.

The primary purpose of this test was to determine the differences in properties among three Oronite 8515 Preservative Fluids and Oronite 8515 High Temperature Hydraulic Fluid in order to ascertain which of the three, if any, would give the desired protection. A secondary purpose was to determine whether flushing of the preservative fluid would be necessary prior to installation of component parts.

SUMMARY:

At Convair's request Oronite Chemical Company prepared three formulations of preservative fluids for "screening" to determine their suitability for protection and storage of B-58 hydraulic units.

These fluids, identified by number, contained the following amounts of inhibitor (calcium petroleum sulfonate): 53839R-2%, 53839 A-R-4%, and 53839 B-R-6%. They were blended from base stocks of Oronite 8515 High Temperature Hydraulic Fluid.

Physical and chemical property tests, designed to disclose degree of rust prevention as well as similarities and differences to those of Oronite 8515 were conducted on all three test fluids.

Results obtained from these tests show that of the three fluids, Oronite Preservative Oil No. 53839 A-R (4% inhibitor) provides the best all around protection against both rust and galvanic corrosion. However, none of the fluids possess the qualities and characteristics desired of a preservative fluid for protection of B-58 hydraulic system parts.

Furthermore, the very high neutralization numbers of all three fluids would possibly make flushing of parts necessary prior to installation.

HYDRAULIC SYSTEM - ORONITE 8515 PRESERVATIVE FLUIDS - EVALUATION OF

OBJECT:

To determine which of three preservative fluid formulations, blended from common stocks of Oronite 8515 High Temperature Hydraulic Fluid, is the most satisfactory for protection of B-58 hydraulic system parts and whether flushing is necessary prior to installation of such parts on the airplane.

DESCRIPTION OF MATERIALS:

TEST FLUIDS	VENDOR
1. Oronite 8515 High Temperature Hydraulic Fluid No. 53865R (as control sample).	Oronite Chemical Co. 200 Bush Street San Francisco, Calif.
2. Oronite Rust Preventative Hydraulic Fluid 8515 No. 53839R (containing 2% Inhibitor, by wgt.).	"
3. Oronite Rust Preventative Hydraulic Fluid 8515 No. 53839 A-R (containing 4% Inhibitor, by wgt.).	"
4. Oronite Rust Preventative Hydraulic Fluid 8515 No. 53839 B-R (containing 6% Inhibitor, by wgt.).	"

SUPPORT MATERIAL	SOURCE
1. Q2715-19 "O"*Rings	Convair Stock

PROCEDURE:

Procedures used in determining physical and chemical properties of the test fluids were as called out in the test request. Where possible, standard procedures were used.

The following is a list of the tests conducted and methods employed:

* Identical to AN 6227-19, except compound is PRP No. 363-70.

	TEST	ACCURACY	METHOD
1.	Viscosity; at -65°F	±0.5%	ASTM D445-53T
	at 100°,210°, and 350°F	±0.1%	ASTM D445-53T
2.	Neutralization Number	±0.1 (No.)	ASTM D664-54
3.	Pour Point	±5°F	ASTM D 99-47

4. Low Temperature Stability - Samples maintained at -65°F for a period of 24 hours. Visual inspection for evidence of gelling, separation and/or crystallization. Viscosity measured at -65°, 100° and 210°F.

5. High Temperature Stability - Samples maintained at 350°F for a period of 24 hours with air excluded. Visual inspection for change in appearance. Viscosity measured at 100°, 210°, and 350°F.

6. Corrosion Protection
   a. Steel Panels - Military Specification MIL-O-6083A, para. 4.3.2.4.1, except all panels polished. Three (3) panels dipped in each test fluid and tested per MIL-O-6083A, para. 4.3.2.4.2, except two (2) Q2715-19 "O" rings arranged between two of each three panels per MIL-P-5516A, para. 4.5.6.

   b. Corrosivity Test - Federal Test Standard No. 791 Method 5322-T, except two (2) steel disks used for each type fluid. Exposure time 200 hours.

7. Effect of Oil Aging on Properties of Seal Material.
   a. Eight (8) Q2715-19 "O" rings were aged for 72 hours at 350°F in each type fluid. The fluid and "O" rings were aged in an air tight container having an air to fluid ratio of 10:1 by volume at room temperature. The fluid to seal ratio was 20 ml of fluid to 1 gram of seal material. The "O" rings were placed flat on steel wire mesh having wire no larger than 0.016" dia. and no more than ten wires per inch. The wire was placed 1/2" from the container bottom.

   b. After the aging cycle the "O" rings were removed and allowed to cool. Then their physical properties were compared with those of non-aged "O" rings by the following tests:

      (1) Tensile Strength Federal Test Method Standard No. 601 Method 4111.

(2) Swell — Federal Test Method Standard No. 791, Method 3603.2.

(3) Temperature of Retraction (TR-10) — ASTM-D-1329-54T

(4) Hardness - Shore "A" Durometer.

It should be pointed out that Military Specification MIL-O-6083A does not apply to these preservative fluids since they are synthetic base oils and MIL-O-6083A applies specifically to petroleum base preservative fluids. No Military Specification has yet been released on synthetic base preservative oils.

RESULTS:

Test results and the relative protection afforded by the preservative fluids are recorded in the following tables and figures:

Table I — "Physical and Chemical Properties of Oronite 8515 Preservative Fluids"

Table II — "Corrosion Protection Properties of Oronite 8515 Preservative Fluids"

Figure 1 — is a bar graph of the tensile strength of Q2715-19 "O" rings after oil aging (72 hours at 350°F) in the test fluids.

Figure 2 — is a photograph of the QQ-S-636 steel panels after humidity chamber exposure as specified in Corrosion Protection Test 6a listed under PROCEDURE.

DISCUSSION:

The increasing number of B-58 Weapons Systems being produced has greatly enhanced the need for a special preservative fluid for protection of hydraulic system parts during shipment and/or storage. The type of fluid desired should:

(1) be compatible with Oronite 8515 High Temperature Hydraulic Fluid

(2) provide excellent protection against both rust and galvanic corrosion

(3) remain stable over a wide temperature range (-65°F to 350°F)

(4) have no deleterious effects on pressure seal materials used in the hydraulic system.

Although the search for such a fluid has been fruitless thus far, it still continues and was the reason for conducting this test.

At Convair's request Oronite Chemical Company prepared three formulations of preservative fluids for screening, using Oronite 8515 High Temperature Hydraulic Fluid as the base stock. Each of these experimental fluids contained a specific amount of active inhibitor. Identification of the test fluids and percentages of inhibitor (calcium petroleum sulfonate) in each is as follows:

	Fluid	% Inhibitor
1.	Oronite 8515 High Temperature Hydraulic Fluid No. 53685R (Control Sample)	None
2.	Oronite Preservative Fluid No. 53839R	2%, by wgt.
3.	Oronite Preservative Fluid No. 53839 A-R	4%, by wgt.
4.	Oronite Preservative Fluid No. 53839 B-R	6%, by wgt.

Physical and chemical properties, as called outin the test request, were conducted on each of the fluids. The data from these tests are contained in Tables I and II and in Figures 1 and 2. A detailed look at these data discloses that:

1. The viscosity of the fluids is increased by the addition of the inhibitor. Although this increase is negligible at high temperatures it is very apparent at low temperatures as shown by the -65°F test. The viscosity of all three preservative fluids exceeds the maximum limit of 2500 centistokes allowed by Convair Procurement Specification FMS-0006A for Oronite 8515.

2. The neutralization number of the fluids, like the viscosity, increased in proportion to the concentration of inhibitor. The neutralization value of a preservative fluid should be nearly identical to that of the fluid that is used for normal system operation (maximum limit of 0.2 allowed by Specification FMS-0006A). Thus the neutralization numbers of all three fluids are exceedingly high and are definitely not comparable to those of the control sample.

3. All three fluids are stable over a wide temperature range, as shown by the low and high temperature stability tests.

4. The fluids have a deleterious effect on Q2715-19 type "O" rings. This is very apparent as shown by tensile strength of the seal material before and after aging. The seals soaked in fluids 53839R, A-R, and B-R were only 40, 37, and 42% as strong, respectively, as the non-aged "O" rings; whereas those aged in the control sample were 57% as strong as the non-aged. These results are shown in Figure 1.

5. None of the fluids offer the desired all around protection against rust and galvanic corrosion. The fluid containing 6% inhibitor had excellent preservative qualities in regard to rust prevention as shown in Figure 2, however the 6% concentration was sufficient to set up electrolytic or galvanic corrosion. Fluid 53839 A-R with 4% inhibitor offered the best all around protection against rust and galvanic corrosion.

For the reasons discussed above none of the experimental fluids are suitable for use as a preservative oil in the hydraulic system of the B-58. Their major shortcomings were found to be in high neutralization numbers, in high viscosities at -65°F and in deleterious effects on "O" rings. Therefore, it is evident that the test fluids would require complete drainage and possibly flushing of hydraulic parts prior to installation.

CONCLUSIONS:

Based on tests conducted by the Engineering Chemistry Laboratory, the following conclusions can be drawn:

1. Of the three formulations tested, Oronite Rust Preventative Fluid 53839 A-R (containing 4% inhibitor) offers the best all around protection. However, none of the fluids possess the qualities and characteristics desired of a preservative fluid for the B-58 hydraulic system. It is true that they are capable of protecting against rust, but this favorable characteristic is offset by the fact that some of their physical and chemical properties differ widely from those of the control sample.

2. The high neutralization number of all three fluids would require that they be completely drained and possibly flushed from all hydraulic parts prior to installation on the airplane.

RECOMMENDATION:

It is recommended that none of the fluids tested be employed as preservative fluids for B-58 hydraulic systems until after their oxidation-corrosion characteristics have been evaluated under T.R. F-8302* (a supplementary test to F-7164 which is now being conducted). In the meantime, it is recommended that Convair

* See GD/FW Report FGT 2483.

contact Oronite Chemical Company to ascertain if it is possible to reformulate the fluids to correct neutralization number and -65°F viscosity.

If satisfactory reformulation can be accomplished, the resulting fluids should be retested. Further evaluation should also include compatibility tests of the preservative fluids with Oronite 8515 Hydraulic Fluid according to the provisions of Specification MIL-H-8446A, para. 4.4.8.

NOTE: Original data may be found in Project Record Books # 10145, and #10146.

REFERENCES

1. American Society for Testing Materials, Vol. V, 1955 Ed.

2. American Society for Testing Materials, Vol. VI, 1955 Ed.

3. Military Specification (2) MIL-O-6083A - Oil; Preservative, Hydraulic Equipment.

4. Military Specification (1) MIL-P-5516A - Packings and Gaskets; Hydraulic Aircraft.

5. Federal Test Method Standard No. 601, 12 April 1955.

6. Federal Test Method Standard No. 791, 15 December 1955.

7. Convair Procurement Specification FMS-0006A.

8. Test Request F-8302 now in progress - same title and supplementary to this test.

PHOTO INDEX

Figure No.	Negative No.	Page No.
1	2-22880	13

ANALYSIS
PREPARED BY
CHECKED BY
REVISED BY

CONVAIR
A DIVISION OF GENERAL DYNAMICS CORPORATION
(FORT WORTH)

PAGE
REPORT NO. FGT-2228
MODEL B-58
DATE 7 April 1959

TABLE I

PHYSICAL AND CHEMICAL PROPERTIES OF ORONITE 8515 PRESERVATIVE FLUIDS

TESTS	ORONITE 8515 HIGH TEMPERATURE HYDRAULIC FLUID 53685R (CONTROL SAMPLE)	ORONITE PRESERVATIVE FLUID 53839R CONTAINING 2% INHIBITOR	ORONITE PRESERVATIVE FLUID 53839 A-R CONTAINING 4% INHIBITOR	ORONITE PRESERVATIVE FLUID 53839 B-R CONTAINING 6% INHIBITOR
Viscosity; ASTM-D445-53T				
Centistokes at -65°F	2388	2701	2724	3658
" at 100°F	20.70	21.42	22.95	23.87
" at 210°F	6.90	7.04	7.36	7.55
" at 350°F	2.93	3.07	3.12	3.12
Neutralization No.; ASTM D664-54	0.08	0.75	1.32	1.77
Pour Point °F; ASTM D97-47	<-100°F	<-100°F	<-100°F	<-100°F
Low Temperature Stability (Aged 24 hours at -65°F)				
Gelling, Separation and/or Crystallization	None	None	None	None
Viscosity; Centistokes at -65°F	2431	2708	2851	3690
" at 100°F	20.46	21.36	22.92	23.88
" at 210°F	6.93	7.02	7.33	7.53
High Temperature Stability (Aged 24 Hours at 350°F)				
Appearance (Visual)	Brown	Dark Brown	Dark Brown	Dark Brown
Viscosity; Centistokes at 100°F	20.18	21.44	22.31	23.50
at 210°F	6.80	6.98	7.28	7.40
at 350°F	2.94	3.08	3.16	3.18
Rubber Compatibility Q2715-19 "O" Rings Aged 72 Hours at 350°F in Each Type Fluid				
Tensile Strength (psi)				
"O" Rings Non-Aged	1,820	1,820	1,820	1,820
" " Aged	1,043	733	675	765
Hardness (Shore "A" Durometer)				
"O" Rings Non-Aged	70	70	70	70
" " Aged	65	60	58	60
Temperature of Retraction (TR-10)				
"O" Rings Non-Aged	-40°F	-40°F	-40°F	-40°F
Aged	-28°F	-20°F	-20°F	-20°F
"O" Ring Swell %	25.64	25.45	25.77	25.13

DEPT. 6
FW 423-3-54

CONVAIR
A DIVISION OF GENERAL DYNAMICS CORPORATION
(FORT WORTH)

TABLE II

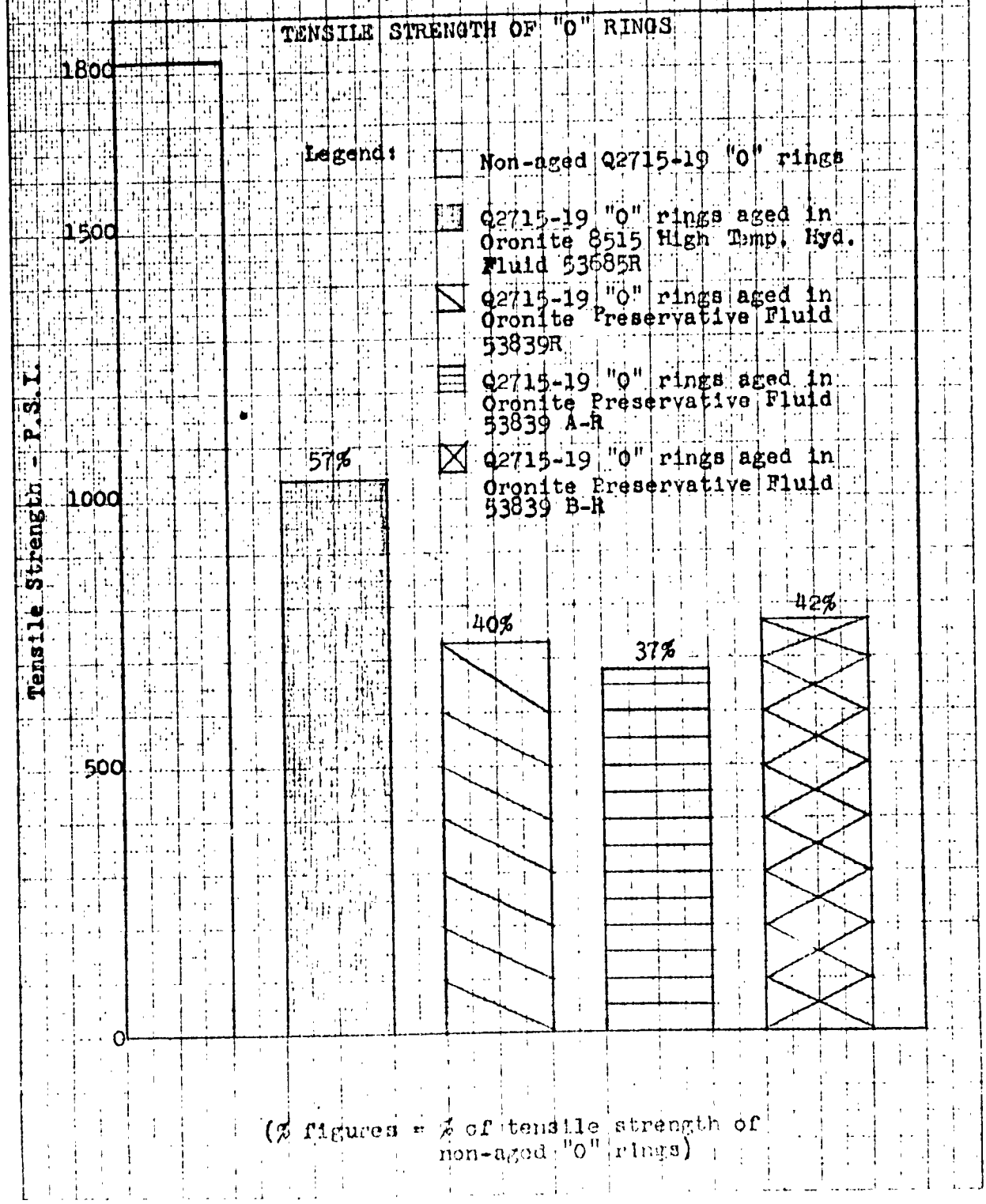
CORROSION PROTECTION PROPERTIES OF
ORONITE 8515 PRESERVATIVE FLUIDS

CORROSION PROTECTION TESTS (as per Test No. 6, page 3)	ORONITE 8515 HIGH TEMPERATURE HYDRAULIC FLUID 53385R	ORONITE PRESERVATIVE FLUID 53839R CONTAINING 2% INHIBITOR	ORONITE PRESERVATIVE FLUID 53839A-R CONTAINING 4% INHIBITOR	ORONITE PRESERVATIVE FLUID 53839B-R CONTAINING 6% INHIBITOR
(Humidity Chamber)				
QQ-S-631 Steel Panels				
Environment: (Rel. Humidity 95%,				
Temp. 120°±2°F, Air 7-9 Cu.Ft./Hr)				
Exposure Time (Hours):	100	100+50*	100	100
Condition of Polished Panels After Exposure:	Failed (Heavy Corrosion)	Passed (3 small rust spots did not increase in size)	Passed (Edges Corroded)	Passed (No Corrosion)
Condition of Panel Surface in Contact with Q2715-19 "O" Rings	Corroded	Corroded	Slight Corrosion	No Corrosion
Corrosion Test (Federal Test Method Standard No. 791, Method 5312.2)				
Environment: (Rel. Humidity 50%, Temp. 80°F)				
Exposure Time (Hours):	200	200	200	200
Condition of Discs After Exposure	Passed	Passed	Passed	Slight Pitting

*3 small rust spots developed within 100 hrs; extra 50 hrs exposure as required by MIL-O-6083A).

FIGURE 1

EFFECTS OF AGING (72 HRS AT 350°F)
Q2715-19 TYPE "O" RINGS IN
ORONITE 8515 PRESERVATIVE FLUIDS



(% figures = % of tensile strength of non-aged "O" rings)

Figure 2

F-7164